# Vision and Cultural Change in Government Satellite Programs

## Three Most Important Approaches to Changing Culture: Communication, Communication, Communication

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One of the most interesting challenges an organization can face is radical change. The urgency for change can have many reasons, including congressional pressure, funding cuts, and new requirements. Whatever the reason, in this article we look at lessons learned when a program manager has a vision for a new way of doing business.

### From Our Perspective

In our work with government space programs we've seen this many times–from programs struggling to deploy new types of sensors to programs faced with increased requirements *and* budget reductions. In this article we summarize the most important program management lessons we've learned from our experiences.

We'll focus on government space programs. The Aerospace Corporation is a Federally Funded Research and Development Center (FFRDC) providing technical support to the Air Force and the National Reconnaissance Office (NRO)

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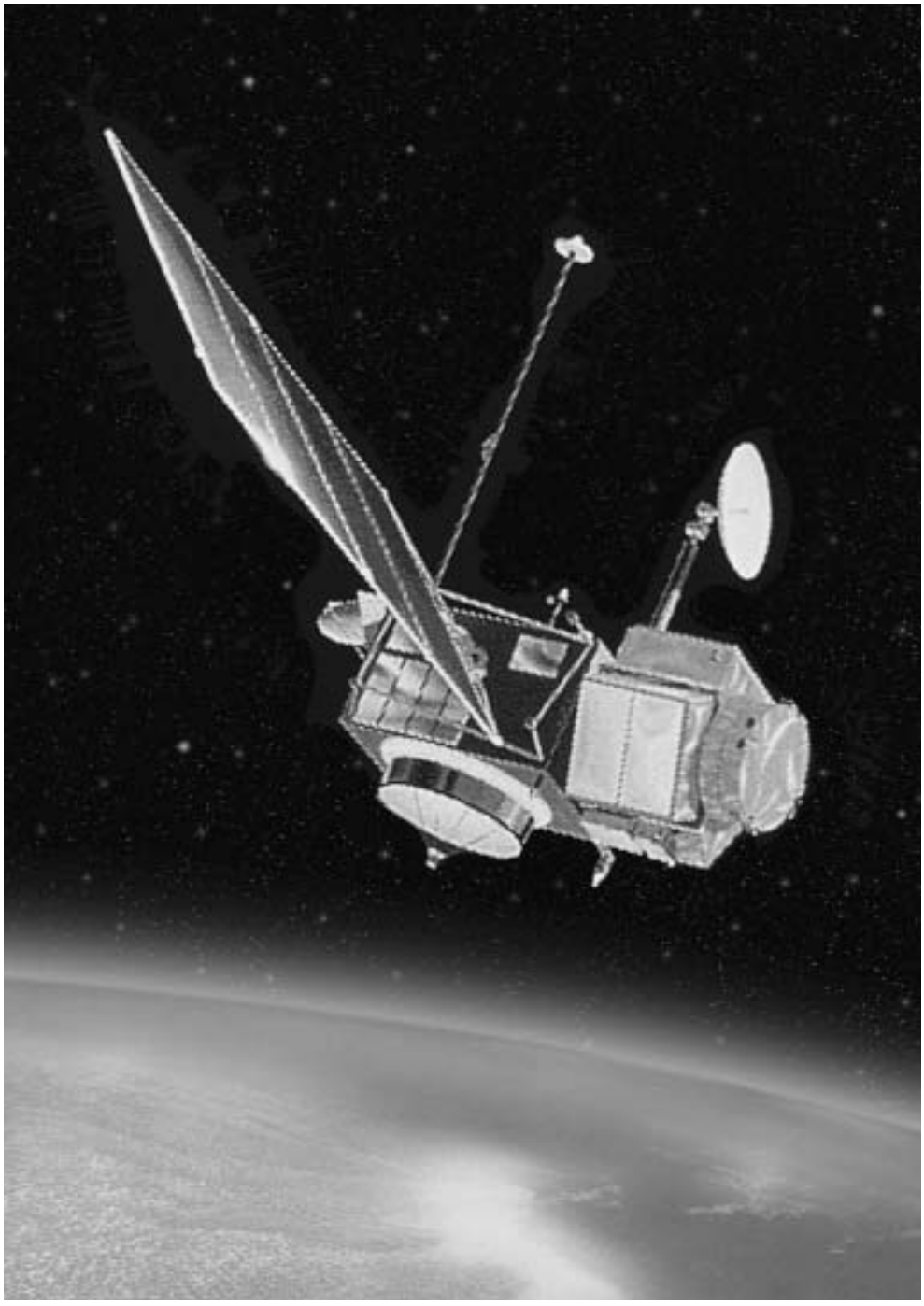

Composite Image by Air Force Staff Sgt. Scott Miller

on virtually all of their satellite programs. The Aerospace Corporation also supports the National Oceanic and Atmospheric Administration (NOAA), and the National Aeronautics and Space Administration (NASA). This gives us a unique perspective across almost all government satellite programs.

Many of these lessons may be familiar to anyone with program management experience. This should come as no surprise; as Aerospace CEO Dr. William Ballhaus likes to say, "*We aren't making any new mistakes–we keep making the old mistakes over and over again.*" Nonetheless, we feel our results may be useful, especially to those with limited insight into the government space program.

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### Nucleus of Lessons Learned

The lessons we cite in this article are based on discussions with government program managers, vendors, and commercial satellite operators. We also drew from our cumulative 50+ years of experience in space programs, and the expertise of our colleagues at the Aerospace Corporation. The Aerospace Corporation also has a robust program of knowledge capture to preserve corporate expertise, and this proved a valuable resource also.

We surveyed six government programs; talked with three vendors of Telemetry, Tracking, and Commanding (TT&C) systems for satellite ground stations; investigated three commercial companies; and reviewed two studies on Commercial Off-the-Shelf (COTS) software to determine lessons learned in developing ground stations. We also surveyed papers presented at the Ground System Architecture Workshop (GSAW) in 2002 and reviewed papers from previous years. The results of these activities form the nucleus of our lessons learned.

## LESSON 1: VISION IS CULTURAL CHANGE

The strategic perspective talks to vision, organizational structure, and culture. These items change at different rates causing conflicts and difficulty in realizing the vision.

Vision defines the future, the goals needed to achieve that vision, and the performance metrics needed to measure progress toward that vision. Vision is relatively easy to obtain. In our experience, most organizational leaders think strategically and have a vision of where they need to be. Where most leaders fail is in creating a strategy to achieve the envisioned future. A strategy is no more than a plan for achieving the organization's goals. It identifies necessary changes to the organizational structure and relationships among organizational components. This seems relatively simple, so why do most strategic plans fail?

The answer is that most leaders view a strategy as a product change rather than a culture change. When a telephone company proclaims the vision of "Broadband Internet provider," they are not simply embracing a new product, but a new corporate culture. They are changing the rules for success that have been used by many of their senior people, and the rules taught to the next generation of leaders. Introducing broadband Internet products the same way *call waiting* was rolled out is a recipe for failure. Changing an organization's culture is difficult; it requires different methods than changing a product line.

A recent satellite program provides a good example of this problem. On his own authority, a director began an innovative effort to reduce costs. He implemented a program of process improvement that would result in substantial reductions in operations and maintenance costs. However, the program was terminated before it had a chance to show results. Why? The director made two mistakes.

- He did not provide a strategic vision to his executive management (this is part of Lesson 3, discussed later in this article).
- He did not spend enough time on cultural issues.

Consequently, most senior managers reporting to him did not embrace the effort. Both his senior managers and executive management evaluated the effort based upon the "old rules"—the existing corporate culture—and judged it unsuccessful. The three most important approaches to changing culture are communication, communication, communication.

The culture of an organization is the set of rules for success that we teach the next generation. These rules are rarely docu-

mented or taught explicitly. They are learned by "osmosis" from the previous generation or created by the employees themselves. This is why it is so hard to change an organizational culture. It often requires a new generation of employees to embrace a new culture, which is why taking five or more years to change an organization's culture is not uncommon. Considering that military personnel typically have a three-year assignment, cultural change in their organizations needs to be sustained across management changes—this exacerbates the difficulty in cultural change.

The strategic perspective helps achieve a vision change by: 1) focusing effort on cultural change, and 2) providing understanding to everybody involved (e.g., operators, system users, budget personnel, executive management, and congressional staffers). If the director mentioned previously had created a strategic perspective and sold that to his management, he would likely have retained the funding he needed for success.

## LESSON 2: CHANGE IS HARD

Even when vision exists and a strategic plan has been created, implementing change remains extremely difficult. *People and organizations resist change.*

A program manager (speaking about eliminating stovepipes within a major government program) said, "Cultural issues can overwhelm good technical engineering." Similarly, the Vice President of a commercial satellite communications company admitted, "The largest hurdle to success for consolidating [satellite operations] is organizational."

In a front-page article, *The Washington Post* pointed out that major corporations in the airlines, electronics, computers, telecommunications, Wall Street, pharmaceuticals, automobile, and fast food industries refused to seriously consider changing their business models during the 1990s—even though clear signs of impending problems existed (S. Pearlstein, "When Business Plans Go Bust," Jan., 2003). These companies included United Airlines, McDonald's, Hewlett-Packard (HP), AOL, Verizon, and every non-discount stock brokerage.

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The results of ignoring your business model can be disastrous, especially when combined with other market factors.

- United Airlines is in Chapter 11 because their labor costs are very high, the spoke and hub approach is generally inefficient from cost and customer satisfaction perspectives, and their service has deteriorated.
- McDonald's experienced its first losing quarter *ever* and is still losing business in the United States due to a more health-conscious public.
- HP bought Compaq in a bitter takeover battle and is trying to find a new identity.
- AOL Time Warner is worth less today than the former Time Warner was worth before the merger, partially because high-speed modems and excellent search engines cut down the need for AOL services.
- Verizon has been losing money on its long distance phone service and has been unable to bring high-speed services to the home—but their recent efforts in the cellular phone market have been successful.
- Traditional stock brokerages have been losing substantial business to discount brokerages because transactions are cheaper and full service has dubious value when customers lose confidence in advice provided by stock brokers.

Recognizing the difficulty of change—and doing something about it—is critical to future success.

## LESSON 3: LEARN FROM SIMILAR SYSTEMS

Tremendous overlap and similarity exists between military and civilian organizations. This is why retired generals like General Gordon Sullivan are able to write successful business books (Sullivan, G., and Harper, M., *Hope Is Not a Method: What Business Leaders Can Learn from America's Army,* Broadway Books, 1997) and have had successful second careers as consultants. Both military and civilian organizations must take advantage of this similarity by looking to the other community for successful (and unsuccessful) business cases.

For example, a typical civilian government Satellite Operations Center (SOC) operates 15 satellites with 12 operators per shift. Does the program manager of the SOC need to build a business case for more consolidated operations? No. The case has already been made in the commercial sector:

- Iridium operates 78 satellites with 6 operators per shift.
- GPS operates 24 satellites with 2 operators per shift.
- Intelsat operates 23 satellites with 3 operators per shift.

- One COTS vendor uses the guideline of 6 to 12 satellites per operator per shift.
- Another COTS vendor uses the guideline of at least 4 satellites per operator per shift.

Of course, there are some differences between the government and civilian sectors. Some government satellites are significantly more complex than commercial satellites. Complexity is not, however, an excuse to ignore this business case, but an opportunity to adapt the business case for the government sector. In this instance, the business case still works for command and control of the satellite, but additional effort is needed for operating the payloads.

Program managers should be aware of similar programs in other sectors, and analyze those programs for successes and failures before embarking on their own changes. This is particularly useful for military program managers, who typically operate under more conservative operating rules than their civilian counterparts. Success and proven technology in the commercial sector can be a bellwether for the military sector.

## LESSON 4: USE BEST PRACTICES

Both NRO and Space Based Infrared Satellite (SBIRS) program office personnel have stated that program risks are relatively low if you plan the effort and use good systems engineering throughout the life cycle.

The following is a list of best practices identified by the organizations we interviewed:

- Automate as much as possible, both operations and the acquisition process. The purpose of this automation is to reduce operations and maintenance cost, and to automate processes that are easy for machines but onerous for people. In the case of acquisitions, define a meaningful metrics program ; i.e., you should be able to make decisions based on the results of your metric calculations. Automate the collection of metric data and the analysis of this data whenever possible. In the case of operations, minimize the number of people needed to operate a system.
- Use a high-level system perspective. Incorporating operational concepts for security, training, and maintenance into the system architecture avoids future costs. For example, analyzing problems or anomalies "at the factory" reduces the need for on-site maintenance engineers.
- Use Web technology for system and operational documentation. In many cases, this approach can be expanded to include product distribution.
- Learn what technologies and processes your contractors are using for their commercial work. Learn why they are used and apply them to your acquisitions. Write your contracts so that contractors use these technologies and processes for their government work also.

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For example, all of the major prime contractors in the space business use six sigma and lean manufacturing processes for their commercial work, but program offices generally ignore these methods. Set up a win-win approach. One such approach is to structure an operations contract in a way that allows the contractor to benefit financially from reducing the cost of operations. Suppose a contractor received an incentive award of 50 percent of the validated cost savings for the first year and residuals (at a lower percentage) for each of the following years of the contract. With this type of structure, everybody wins.

### Applying These Lessons to COTS Satellite Ground Systems

Over the past decade, COTS systems (both hardware and software) for SOCs have become commercially available and provide a good example of many of these lessons learned. When COTS first became available, many government satellite program managers recognized the opportunity for substantial cost and risk savings, and hurried to embrace a COTS philosophy. Yet even today there are few government satellite programs using purely COTS solutions for ground operations. Why?

Initially, many programs with the vision of COTS failed to embrace the strategic perspective needed to achieve cultural change (Lesson 1). For example, many programs tried to acquire COTS software using their familiar DoD acquisition processes. They began acquisition by developing requirements completely independent of COTS capabilities. They did this to "prove" to their management that with a level playing field, COTS solutions would show significant cost and risk savings (Lesson 3). Of course, the exact opposite occurred. Custom requirements forced a custom solution; building that on top of COTS software was actually more expensive than writing it from scratch.

Programs that did succeed in fielding COTS systems often had problems with operations (Lesson 2). For example, many programs used their traditional model of software updates: heavily controlled, massive updates on yearly or longer intervals. By the time the program was ready for a software update, the underlying COTS might have gone through two, three, or even more releases. This forced the program to "leapfrog" updates, something that is usually poorly supported by the COTS vendor, and which introduced large amounts of change into the operational system.

In another example of Lesson 1, a prominent consolidation effort failed because the organization was not prepared to accept the cultural change that led to reduced staffing. Through consolidation and automation, the effort eliminated a number of operational positions within the program. But because the program manager had not properly prepared the organization for this cultural change, upper management refused to reduce staffing. And without the reduced staffing, the project's cost savings were lost.

Later programs have been more successful by taking advantage of these lessons learned. First, they recognized that the success of COTS in the commercial sector had already proven the business case, freeing them to use new models of acquisition. Second, they embraced a strategic perspective and based system requirements on known COTS capabilities, improving the cost and risk savings. Third, they recognized the difficulty of changing operations, and spent additional effort to prepare management for cultural change, create new concepts of operations, and train operators accordingly.

Our discussions with vendors and companies offering satellite communications services echoed many of these same lessons:

- Adapt your concept of operations to match the COTS products—not vice versa! This is the major pitfall of COTS use. If you insist on modifying COTS software to meet the way you have traditionally done business, the cost will rise and significant custom code will be required, obviating most cost savings.
- Keep current—implement vendor releases. In some situations, it is acceptable to "freeze" a system at a particular release. But most new systems are not static; they evolve for increased functionality, for interoperability with other systems, etc., and all these goals are more easily achieved with up-to-date software. It is also easier and more cost-effective to upgrade incrementally, rather than making a big "jump" caused by skipping releases.
- In satellite operations, COTS command and control systems represent a savings, but still require substantial tailored code.
- Be wary of licensing fees and operational costs. Many acquisitions focus on the purchase costs and ignore or place a low priority on continuing operational costs and licensing fees. However, systems often outlast expectations, compounding the impact of high operational costs and licensing fees.

The Aerospace Corporation investigated why acquisitions using COTS continue to have cost overruns and performance problems. The conclusions:

- The acquisition organization (government or civilian) cannot control critical aspects of COTS. You do not need to use all of the functional capabilities of COTS software packages. Using the underlying concepts of operations of vendor-supplied software eliminates integration problems.
- A 1981 (!) Jet Propulsion Laboratory document on the Deep Space Program showed software reuse (including COTS) can produce substantial savings, but still requires about 12 percent of the purely custom development cost for test and integration. Our experience in the years since then indicates that 12 percent is, if anything, a low estimate.
- Whenever possible, create win-win situations—partnerships are useful. Vendors are not bad guys. They need to make a profit to survive, so work with the vendors. When vendors understand your problems, they may be able to resolve some of them in future releases.
- Don't modify the COTS. If you need to change something to get the vendor software to work, first try to get the vendor to make the modification. If that is impossible, keep changes external and isolated from the commercial software.

Finally, as specified in a Mitre study, COTS savings are generally overstated; difficulty and limitations are generally understated. When using COTS, learn as you go; adjust plans accordingly.

## Accept, Sell, Implement

The program manager with a new vision for his or her organization faces numerous challenges. In our experience, most of these are cultural and organizational, and the program manager who recognizes this, and plans for it from the inception of his or her vision, has a much greater chance of success.

- Accept that a new vision means cultural change.
- Sell the cultural change to executive management.
- Implement change with best practices.

As a closing note, it is interesting to observe that the lessons cited in this article are very similar to the lessons published in 1976 by the General Accounting Office (Lessons Learned About Acquiring Financial Management & Other Information Systems). Most of those lessons involved leadership, managing change, and using best practices. While technologies change from year to year, the management challenges of adopting and adapting to those changes remain fundamentally the same.

Vision is not a new *product*—it is a new *culture*.

**Editor's Note:** The authors welcome questions or comments on this article. Contact them at shere@aero.org and srt@aero.org.